Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/603
SWEDEN
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

The Design of the Marviken Boiling Heavy Water Reactor with Nuclear Super-Heating

P.H. Margen [1], E. Höjgaard [2], L. Leine [3], R. Nilson [1]

The second Swedish power reactor, Marviken, was originally intended to be a pressurized heavy water power reactor for 105 Mw elect. Studies on larger reactors made during 1961 and 1962, however, suggested that direct cycle boiling heavy water reactors with natural circulation were feasible and that they effected considerable reductions in capital costs due to the entire elimination of the primary cooling circuits with steam generators. It was therefore decided to redesign Marviken as a reactor of this type and to incorporate in addition the possibility of nuclear super-heat which had also been studied in some detail. For the new design the output of Marviken was increased to 140 Mw elect. for saturated steam operation and 200 Mw elect with nuclear super-heat operation. Manufacture of the pressure vessel started in 1963 and the station is scheduled for commissioning in 1968.

The boiling elements consist of Zircaloy clad UO_2 rod fuel clusters whilst the first super-heater charge is planned with Cr/Ni alloy clad UO_2 rod clusters. The average burnup is currently scheduled for 13000 Mwd/t-U and the average enrichment of the entire fuel charge with super-heat operation will be about 1,35 %. Natural uranium operation is possible with saturated steam. The engineering features include on-load fuelling of the elements for the boiling channels. The containment is of the pressure suppression type with a dry well of pre-stressed concrete. The turbine has special measures for minimizing leakage.

1) AB Atomenergi, Stockholm
2) State Power Board, Stockholm
3) ASEA, Västerås

The paper describes the reactor and station and reviews the main development work carried out for Marviken. Reactor operation and safety aspects are also discussed.

The development work includes extensive tests on hydrodynamic instability, static and dynamic burnout, steam water separation, can corrosion and erosion, heat transfer with super-heated steam on roughened surfaces, zero energy physics, water chemistry etc., and calculations on related topics such as void feed back instability and form factors. Leakage prevention for components in the direct cycle has been investigated in a special programme including tests on two 160 Mw elect. condensers in Sweden and tests on a full scale turbine shaft seal. The work completed so far has given considerable encouragement concerning the performance with saturated steam, and the first information concerning performance with super-heated steam is also accumulating.

It is hoped that the information produced by the design, construction and operation of the Marviken station will form the foundation for building a larger fully competitive nuclear power station as the next step.